

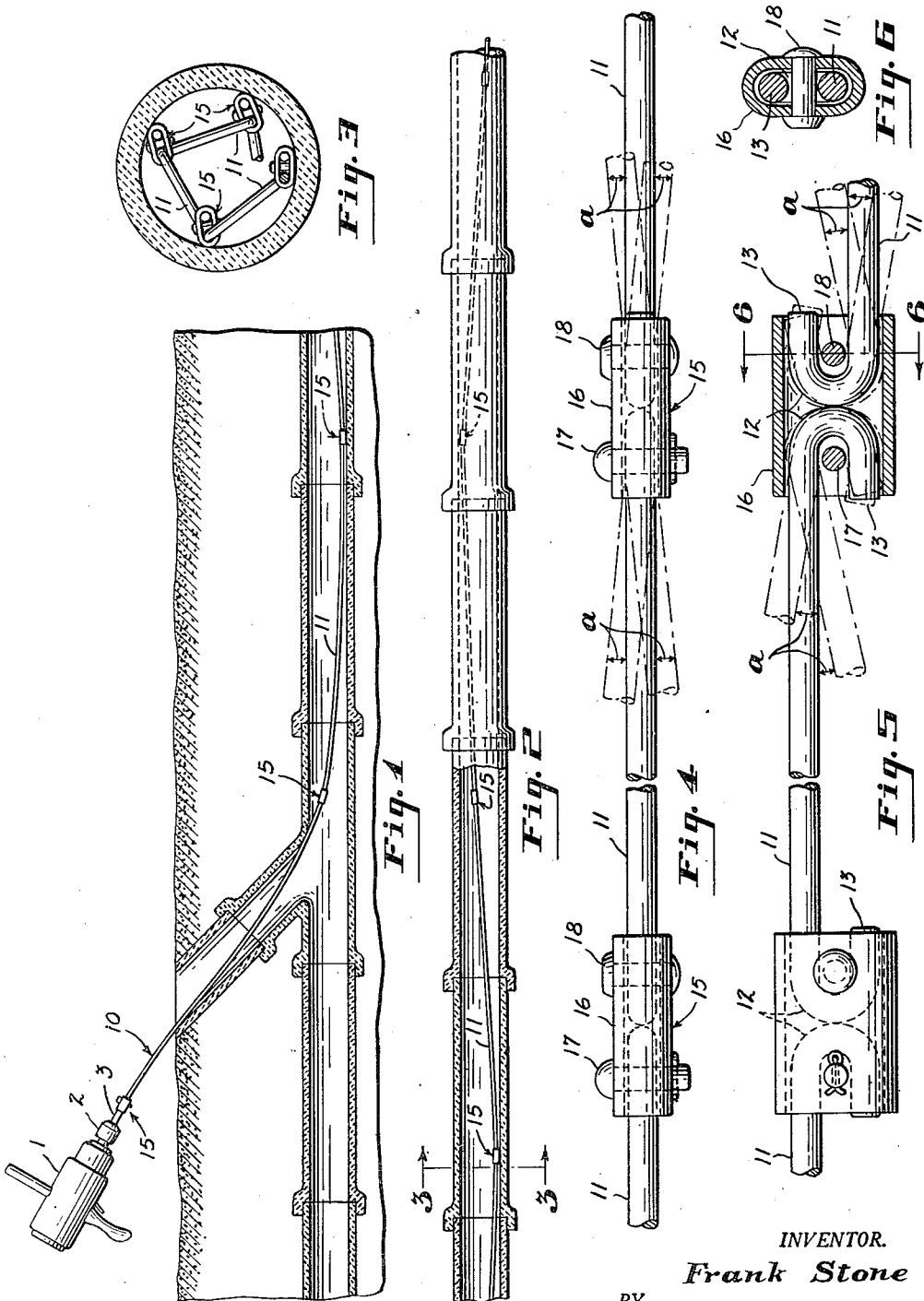
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SEWER MOLE

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SEWER MOLE

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This invention relates to an improvement in sewer moles or drills and, more particularly, to an improved drive shaft for the rotary cutter of a sewer mole.

The well-known sewer moles are widely employed for cleaning out sewers and drains which have been clogged or blocked by roots and silt. The advantage of sewer moles is that their successful use avoids the expense and delay of digging up a sewer to clean out a clogged portion. The successful sewer moles of the prior art are basically comprised of a rotary cutter having expandible cutting blades, said cutter being driven by a suitable motor through a flexible cable. The cutter is usually fed into an opening in the sewer at a point beyond small traps, the flexible cable permitting the rotary cutter to be driven past angles, bends and traps in the sewer. The driving motors are usually so heavy that they must be mounted on a portable base.

The sewer moles of the prior art, however, were substantially limited to use in comparatively short house sewers which were not badly clogged. To be effective, the rotary cutter must be driven at a high rotational speed. If, after the cutter had been fed an appreciable distance, a hard obstruction, such as a large root, were met, the cutter would be stopped and the torque on the flexible cable would coil the cable within the sewer pipe. Once a cable commenced to coil, application of additional torque would primarily tend to expand the coiled cable against the walls of the sewer pipe, thus jamming the coiled cable tighter and either stopping the motor or causing the usual overload clutch to slip or throw out. Thus, the maximum size and hardness of an obstruction which a prior art mole could remove decreased very rapidly as the distance of cutter feed increased.

Another limitation on prior art moles was the weight and bulk of the equipment. The above mentioned tendency of a flexible cable to coil limited the distance of cutter feed to approximately a hundred and fifty feet, for most practical purposes, even though no particularly hard obstructions were encountered. The bulk and weight of this amount of cable and the equipment to drive it was about all two men could handle. Efforts to couple shorter and more conveniently handled lengths of cable or drive rod were not successful because the rigid couplings available to the prior art would snap under load.

It is an object of this invention to provide a sewer mole and, more particularly, a non-coiling sewer mole drive shaft which has sufficient flexi-

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bility to permit a rotary cutter to be driven past standard bends and which will permit a cutter to clear harder and larger obstructions than could be cleared with prior art devices. It is another object of this invention to provide a sewer mole which can be driven for distances much greater than those of the prior art without appreciable loss in the ability to clear obstructions. A further object of my invention is to provide a cutter drive shaft which, itself, exerts a cleaning and reaming action. A still further object of my invention is to provide a sewer mole in which the drive shaft is so light and so free from a load due to binding against the sewer pipe that a manually supported electric drill motor is ample to drive the shaft and cutter.

It is an advantage of my invention that one man can conveniently handle all the equipment necessary to clean several times the length of sewer which a prior art device could generally clean. A still further advantage of my invention is that I have provided a coupling which is extremely simple and positive.

Other and further objects and advantages of my invention will be apparent from the following specification, claims and drawings in which:

Fig. 1 is a sectional view showing my sewer mole in use.

Fig. 2 is a continuation of the sewer line shown in Fig. 1.

Fig. 3 is a cross-section taken along the line 3—3 of Fig. 2.

Fig. 4 is a plan view showing coupled lengths of my drive shaft and indicating the angular movement permitted by my coupling in the plane of illustration.

Fig. 5 is an elevation of my drive shaft as shown in Fig. 4, partly in section and indicating the angular movement permitted by my coupling in the plane of illustration.

Fig. 6 is a section taken along the line 6—6 of Fig. 5.

A sewer mole employing my invention may be comprised of any suitable rotary cutter (not shown) and a suitable driving motor 1 provided with a chuck 2 which engages a suitable bit 3 connected to the drive shaft 10 through its coupling 15 to drive the rotary cutter. As shown in Fig. 1, the motor 1 is a conventional manually supported drill motor. The rotary cutter is preferably connected to the drive shaft 10 by a coupling similar to the couplings 15 which are employed to connect the several lengths of my drive shaft together.

My drive shaft 10 is comprised of a plurality of

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lengths of spring steel rod 11, each end of which, in the preferred embodiment shown, is provided with a full 180° reverse bend 12 having an internal radius approximately equal to the radius of the rod 11. The reverse bends are preferably provided with end portions 13 which are parallel to the length of the rod, said end portion extending beyond the bends 12 for a distance usually at least more than equal to the diameter of the rod, in order to secure the rods 11 in the coupling sleeves 16.

The minimum size of house sewer pipe permitted by most building codes is four inches and the average size connecting to a main sewer is six inches. My spring steel rods 11 are preferably about one-quarter of an inch in diameter (i. e., about one twenty-fourth of the diameter of the average pipe to be cleaned) and about five or six feet in length (i. e., about ten or twelve times the diameter of the average pipe to be cleaned.) I have found that coupled spring steel rods so proportioned will flex around standard bends and angles in standard sizes of sewer pipe without permanent deformation to the rod or damage to the pipe and without coiling, when such rods are coupled with my limited universal coupling 15. The diameter of the rod 11 may, of course, vary from as large as one-eighteenth the diameter of the average sewer to be cleaned to as small as one-thirtieth; larger rods are frequently too stiff and smaller rods are more flexible than necessary and may tend to coil. The length of my rod is largely limited by convenience in handling. Rods which have a length much less than eight times the diameter of the average pipe to be cleaned necessitate a greater number of couplings and are thus impractical; rods longer than about sixteen times the diameter of the average pipe to be cleaned are difficult to handle and may tend to whip when an additional length of rod has been added to the shaft 10.

The limited universal coupling 15 is preferably comprised of a flattened malleable steel sleeve 16 having an internal vertical height slightly greater than the overall height of the reverse bend 12 and an internal width slightly greater than the diameter of the rod 11. The necessary tolerances of the sleeve 16 will be explained below. The sleeve 16 is made most simply by flattening a short length of malleable steel tubing. The sleeve 16 may, of course, be made in other ways, as by machining from bar stock, forging, and the like; the sleeve may also be separable rather than unitary, as shown.

Each sleeve 16 is provided with a pair of transverse pivot pins 17 and 18, at least one of which should be removable to permit the drive shaft 10 to be assembled and disassembled at the coupling. The pivot pins are located with respect to the height of the couplings 15 and with respect to each other so that the pins will be engageable within oppositely disposed reverse bends 12 of a pair of rods 11. Preferably, when the pins so engage the reverse bends 12, the outside surfaces of the reverse bends are substantially in rolling contact with each other, as shown in Fig. 5. Also, one of the pins, in this instance the pin 17, is removably secured in the sleeve 16 in order that the rods may be quickly and conveniently connected and disconnected. In order to prevent the sleeves 16 from being misplaced, the other pin 18 is riveted in place so that, when the rods 11 are disconnected, the sleeve 16 will stay upon the rod 11 and cannot be removed therefrom.

A tolerance between the internal walls of the

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sleeve 16 and the reverse bends 12 is provided so that either in the plane of illustration of Fig. 4 or in the transverse plane of illustration of Fig. 5, the rods may freely pivot about the pins through an angle indicated as α , thus permitting limited universal angular movement between coupled rods 11.

The couplings 15 are relatively inflexible and exert a stiffening influence upon the coupled rods 11, which are, of course, also stiffened at their end portions by the reverse bends 12. The amount of angularity of the angles α permitted by the tolerance of the sleeve 16 is preferably such that the angular movement of coupled rods 11 with respect to each other will offset the stiffening influence of the couplings 15. By so designing the tolerance between the sleeve 16 and the reverse bends 12, the tendency of the rods 11 to snap adjacent the couplings 15 is prevented and, in so far as the overall flexibility of the shaft 10 is concerned, the flexibility is substantially equivalent to that which would be obtained if the shaft were a continuous rod 11. At the same time, if the shaft 10 is subjected to such torque as would tend to cause a continuous shaft or rod 11 to coil, the relatively free universal movement permitted by the sleeves 16 allows the jointed shaft 10 to form into an approximate helix in which the rods 11 are relatively straight chords subtending the hypothetical curve of such helix. Consequently, when the jointed shaft 10 is under load within a sewer, the shaft engages the internal walls of straight sections of the pipe only at the couplings 15, as shown in Fig. 3 of the drawings.

In use, the disconnected rods 11 are conveniently bundled and carried to the sewer opening into which the drill is to be fed. The rods are so light that a bundle sufficient for most jobs can be carried by one man. A few of the rods are coupled together to form a shaft 10 which is connected between the rotary cutter and the drill motor 1. As the shaft 10 is fed into the sewer to force the rotating cutter ahead of it, the flexibility of the jointed shaft permits the cutter to be driven past the bends likely to be encountered, additional rods 11 being coupled to the shaft as required, the removable pins 17 being temporarily locked, as with the cotter pins shown. As the shaft is fed into the sewer, the centrifugal force of the rotating shaft and the compression load thereon forces the couplings 16 into engagement with the walls of straight sections of the pipe. At and adjacent bends and angles in the pipe, the limited universal movement permitted by the couplings prevents the portion of the rods 11 adjacent the couplings from being subjected to a greater strain than is placed on other sections of the rods 11.

Due to the fact that the adjacent reverse bends 12 in the couplings 15 are in substantial rolling engagement and because the couplings 15 are in engagement with the walls of the sewer pipe, when the cutter strikes a hard obstruction, there is no lost motion to be taken up in the shaft 10 and thus there is no detrimental loss of cutter speed. Further, the energy stored by the inherent resilience of the shaft 10 when the shaft is subjected to a sudden shock load is not lost in a binding action against the pipe walls, because the couplings 15 permit only widely spaced point contact with the pipe walls. Of particular importance, however, is the fact that my drive shaft is so light and relieves the driving motor of the frictional load normally carried by engagement

of the coiled driving cable with the pipe walls that a manually held and supported drill motor may be employed. Not only does the use of a lighter driving motor permit one man to handle the entire mole, but, of more direct importance, the motor may be held in the hands of the operator when in use. Thus, the operator is able to feel the load and torque upon the motor 10 and to control the rate of feed of the cutter accordingly. As the operator quickly acquires skill, he will feel the cutter strike hard obstructions and, immediately, reduce the rate of feed, thereby further preventing jamming of the mole.

Due to the fact that my drive shaft does not readily permit a detrimental loss of cutter speed, moles employing my shaft 10 can cut through obstructions which would stop similar cutters driven by prior art driving connections which permit binding. Consequently, my drive shaft permits the cutter to be driven much greater distances without appreciable loss in effectiveness. Still further, because the couplings 15 engage the pipe walls, my shaft, in and of itself, exerts a cleaning and reaming action as the shaft is rotated.

Use of my drive shaft has disclosed that the load of the drive shaft at the couplings 15 is carried primarily by the reverse bends 12 and sleeves 16 and not by the relatively weak pivot pins 17 and 18. This is evidenced by the fact that wear on the reverse bends is shown to the greatest extent at the points where the reverse bends are in engagement with the sleeves 16 and adjacent reverse bends. Further evidence that the load of the drive shaft is not primarily carried by the pivot pins is found in the fact that a coupling has not disconnected under load even when a removable pin 17 was not properly secured and fell out during use; this is due to the fact that the canting of the sleeves 16 with respect to reverse bends 12, when the shaft is under load, causes the sleeves to grip the reverse bends. In use, therefore, the shaft 10 is preferably rotated as it is withdrawn from the sewer to avoid possible disconnection of the shaft due to loss of a removable pin 17.

In use, the rods 11 may be coupled so that the rods are aligned, as shown at the coupling at the left in Fig. 5 of the drawings, or so that the rods are alternately disposed with respect to the pins 17 and 18, as shown at the coupling at the right in Fig. 5, the latter arrangement generally being preferable. In either arrangement, the sleeves 16 will securely engage the reverse bends due to the length of the portion 13. In this connection, it should be pointed out that the reverse bends are preferably open, as shown, but may be closed by bending the end of the portion 13 against the rod 11 to provide an eye. Likewise, the ends of the rods are not necessarily bent to form the reverse bends 12 but may be upset and machined to provide an equivalent structure.

It should be apparent that my invention is not restricted to the specific preferred embodiment disclosed but may be modified to provide equivalent structures within the scope of the following claims.

What is claimed is:

1. A sewer mole drive shaft comprising a plurality of flexible rods and a universal coupling connecting adjacent rods comprising a sleeve carried by one rod, a transverse pivot pin carried by said sleeve, and a reverse bend in the end of an adjacent rod, said reverse bend being loosely engaged within said sleeve and said pin being loosely engaged within said reverse bend, whereby said coupling permits limited universal angular movement of one rod with respect to an adjacent rod.

2. A sewer mole drive shaft comprising a plurality of flexible rods, one end of each of said rods being formed into a reverse bend and the other end of a rod carrying a coupling sleeve, and a transverse pin carried by each of said sleeves, said sleeves having internal dimensions greater than the corresponding external dimensions of the reverse bend of an adjacent rod engaged in said sleeve, and said pin being loosely engaged within said reverse bend.

3. A sewer mole drive shaft comprising a plurality of rods which are relatively flexible transversely and relatively stiff longitudinally, the ends of each of said rods being bent to provide reverse bends having an internal diameter approximately equal to the thickness of said rods, and a coupling connecting adjacent ends of a pair of said rods, said coupling comprising a sleeve having internal dimensions larger than the corresponding dimensions of said reverse bends, reverse bends of a pair of adjacent rods being loosely received in said sleeve, and a pair of pins extending transversely of said sleeve and loosely engaged in the reverse bends received in said sleeve.

4. A separable non-coiling drive shaft for a sewer mole comprising a plurality of spring rods relatively flexible transversely and relatively stiff longitudinally, reverse bends formed in the ends of said rods, a flattened sleeve carried by each of said rods and adapted to loosely receive the reverse bends of said rods, a fixed transverse pin carried by and positioned in said sleeve to be loosely engaged in a reverse bend of the rod carrying said sleeve, and a removable pin carried by said sleeve to engage the reverse bend of an adjacent rod, said pins being spaced with respect to each other to maintain adjacent reverse bends in substantial rolling contact when said shaft is under a compression load.

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